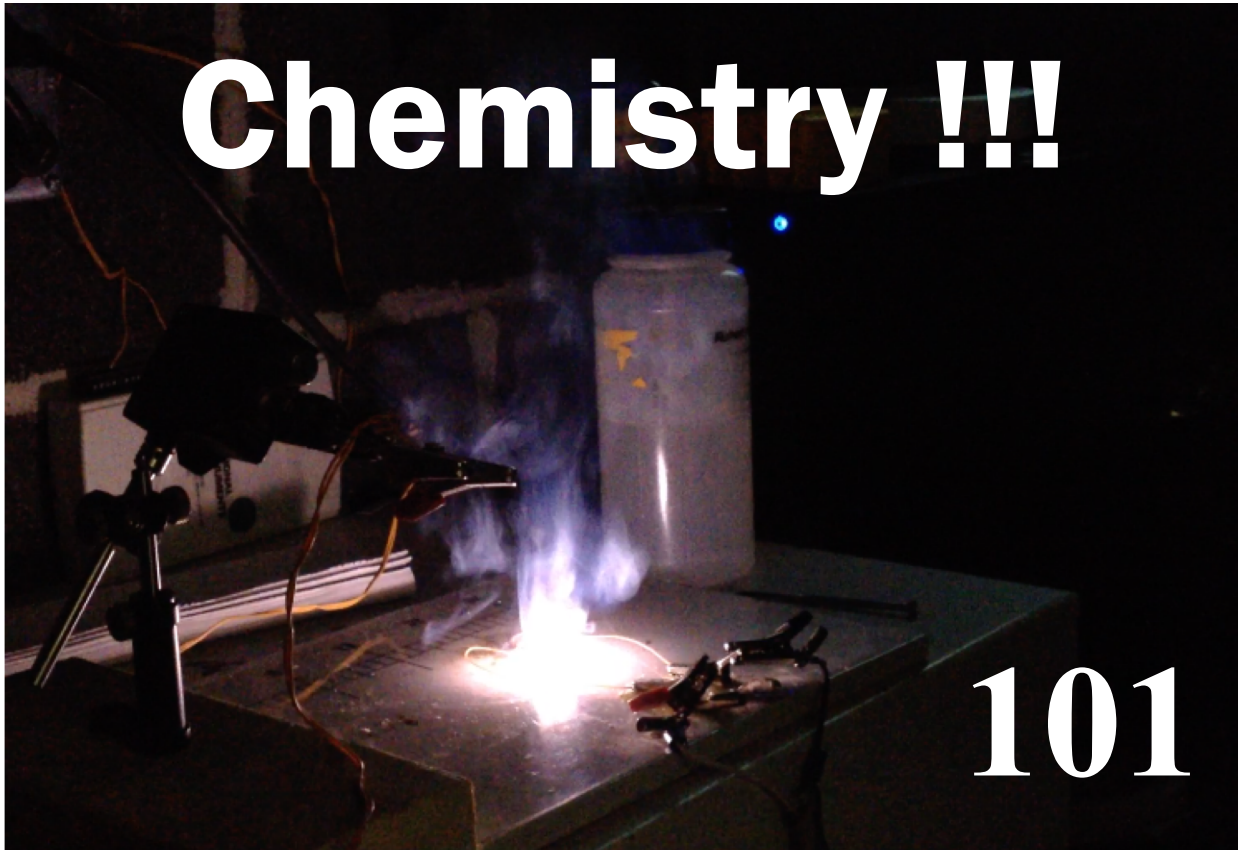


Chemistry !!!



101

Fall 2019

Dr. Maria A. Donnelly
Beaupre 117C
madon@uri.edu

Why Learn Chemistry?

To better understand the environment around us

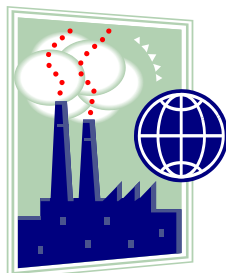


Medicine

- Understanding disease
- Develop new drugs

Environmental Science

- Ozone layer
- Global warming
- Acid rain



Agriculture

- Bioengineered food
- Fertilizers

Criminal Justice & Safety

- Forensics
- Explosives & Drug detection
- Safety equipment



Material Science

- Better built houses
- More efficient cars
- Plastics, composites



Why Learn Chemistry?

Fun!

3

Fireworks!



New materials for sports equipment!



Better electronic devices
& gaming systems!



High tech clothing
for any activity!



Expectations

CHM101 – Freshman Chem. Lecture (lab – CHM102)

- Required if 3–4 semesters of chem. required by major
- Pharmacy, Engineering, Biology
- Pre-professional programs: med, dental, veterinary etc.
- Some environmental science groups
- **Emphasis on mathematical skills (esp. algebra) & problem solving (most exams ~ 80% math)**
- **Other General Chemistry courses – 103, 191**
- Grading:
 - Connect on-line homework & Learnsmart + Quizzes(15%)
 - Four lecture exams (68%)
 - Final exam (17%)
 - to calculate: $(\text{HW avg} * 0.15) + (\text{exam avg} * 0.85)$
- Details in syllabus

Your choices will determine your level of success

- **Attendance is important**
 - prepare in advance – become familiar with key terms & ideas
 - pay attention, ask me questions
 - print out slides and bring them with you to take notes on
- **Assignments are designed to help you learn**
 - focus on WHY you need to follow certain steps to solve problems rather than trying to memorize the steps
 - ask yourself what you do and do not understand
- **Complete assignments on time**
 - mastery of early material will help with material covered later
 - avoid having assignments build up & losing points due to lateness
- **Seek help right away!**
 - office hours & **RECITATION SESSIONS!**
 - TAs in Beaupre 115 Learning Center
 - AEC tutoring group or walk in tutoring

Be Courteous to Your Classmates

- If you arrive late/need to leave early, use the back entrance
- Your peers can be a great resource, but please wait till after lecture to talk with them/ask them questions
- Give everyone a chance to answer
- Remember why you are here
 - TV shows, games, movies, & social media will not help you learn
 - they are also visible to the students sitting behind you & can be quite distracting

Useful Information: Sakai

Where to find lecture slides & other useful information

Overview

Welcome

CHM 101 is a general chemistry course designed to introduce a variety of concepts and principles that are fundamental to the study of chemistry. Significant emphasis will be placed on mathematical skills and problem solving.

Instructor: Dr. Maria Donnelly
Email: madon@uri.edu
Office: Beaupre 117C
Office hours:

Office hour appointments should be made through the Starfish Success Net - simply click on the link below. Appointments are not required but students with appointments will be given priority over those who have not made appointments. During walk-in hours, appointments are not accepted and multiple students may be helped at the same time.



[Link to Student Resources \(Lecture slides, Syllabus, Sakai information, Connect information, Lists of vocabulary that you should know for each chapter\)](#)

[Link to the Course Connect Registration/login page](#)

[Link to TA Office hours in Beaupre 115*](#)

*Office hours are listed based on lab; the TAs for this course would be the CHM102 TAs

Recent Announcements

Options

Announcements
 (viewing announcements from)

There are currently no announcements.

Calendar

Options Publish (private)

September 2018

Sun	Mon
2	3

Starfish!
 For making
 appointments, etc.

Useful Information: Sakai

Adding (or removing) courses from tabs in Sakai

The screenshot shows the Sakai LMS interface for the University of Rhode Island. The top navigation bar includes a 'Home' button, two course dropdown menus (2179-CHM1010002: Gene ... and 2179-CHM1010006: Gene ...), and a 'Sites' button circled in red. A red arrow points from the 'Sites' button to the 'Organize Favorites (3)' drawer at the bottom. Inside this drawer, the 'Sites' tab is selected. Under the 'Spr 2018' section, three courses are listed, each with a yellow star icon and a dropdown arrow. Red arrows point from the text 'Yellow stars will show up as tabs' to these yellow star icons. The 'OTHER' section shows a 'Home' dropdown, and the 'PROJECTS' section is partially visible.

Yellow
stars will
show up
as tabs

Useful Information: Lecture Notes, etc.

Home

People ▾

Research

For Prospective Students

For Current Students

Links ▾

Contact Us

Teaching

Dr. Donnelly's CHM 101 Student Resources

Course Information

- Syllabus
- Sakai Information Guide
- Beaupre 100 Seating Chart

Connect Information

- General Connect Information
- Registration Information

Lecture Slides

- Chapter 1
- Chapter 2
- Chapter 3
- Chapter 4
- Chapter 5
- Chapter 6
- Chapter 7

Useful Information: Connect

Registration Information
is section specific!

Your Section!

Section 1:
Spring 2018
TTh 9:30 am

connect

student registration information
course

Spring 2018 CHM 101 General Chemistry
with LearnSmart and LearnSmart Prep

instructor

Maria Donnelly

section

Spring 2018 Section 1 TTh 9:30 am

online registration instructions
Go to the following web address and click the "register now" button.

<https://connect.mheducation.com/class/m-donnelly-spring-2018-section-1-tth-930-am>

This is a unique address for
Spring 2018 Section 1 TTh 9:30 am

Having trouble registering?
Get help here: <http://bit.ly/StudentRegistration>

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Section 2:
Spring 2018
TTh 11:00 am

connect

student registration information
course

Spring 2018 CHM 101 General Chemistry
with LearnSmart and LearnSmart Prep

instructor

Maria Donnelly

section

Spring 2018 Section 2 TTh 11:00 am

registration dates

01/18/18 - 05/01/18

online registration instructions
Go to the following web address and click the "register now" button.

<http://connect.mheducation.com/class/m-donnelly-spring-2018-section-2-tth-1100-am>

This is a unique address for
Spring 2018 Section 2 TTh 11:00 am

Having trouble registering?
Get help here: <http://bit.ly/StudentRegistration>

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Section 4:
TTh 9:30 am

connect

student registration information
course

CHM 101 General Chemistry Lecture
with LearnSmart and LearnSmart Prep

instructor

Maria Donnelly

section

2019F CHM 101 Section 4 TTh 9:30 am

online registration instructions
Go to the following web address and click the "register now" button.

<https://connect.mheducation.com/class/m-donnelly-2019f-chm-101-section-4-tth-930-am>

This is a unique address for
2019F CHM 101 Section 4 TTh 9:30 am

Having trouble registering?
Get help here: <https://bit.ly/StudentRegistration>

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Link to registration page

Useful Information: Connect Registration

connect

FALL 2018 CHM 101 GENERAL CHEMISTRY
FALL 2018 CHM 101 SECTION 4 TTH
9:30 AM

INSTRUCTOR
MARIA DONNELLY

GENERAL CHEMISTRY: THE ESSENTIAL CONCEPTS
RAYMOND CHANG, 7TH ED.

Welcome

Enter your email to join this class:

Email

By using this site you agree to the Terms of Use and Privacy Notice.

BEGIN



Create your McGraw-Hill Education account.

Email Address
madon@my.uri.edu

Confirm Email Address
Confirm Email Address

Password
Password

Confirm Password
Confirm Password

Passwords are case sensitive and must contain 8-20 characters including: 1 uppercase character, 1 lowercase character and 1 number. (No spaces)

First Name
First Name

Last Name
Last Name

Security Question
Select a Question

Security Answer
Security Answer

We'll ask you this question to retrieve your password.

Mobile Number
(optional, [get important text alerts](#))
Mobile Number

☐ I agree to the terms of the McGraw-Hill Education Terms of Use and Privacy Notice.

CONTINUE



Instructor:
Maria Donnelly



Chang: General Chemistry: The Essential Concepts
7TH EDITION
Raymond Chang, Kenneth Goldsby



Student Registration



General Chemistry: The Essential Concepts
ISBN:0077623290
Edition:7
Author:Raymond Chang, Kenneth Goldsby

What you get with Connect:

- Digital Access to the textbook
- Interactive tools that will help you focus your study time
- Exclusive discounts on a print copy of the textbook

Already purchased?

To access your course materials, first enter your 20 digit registration code.

Registration Code:

Example: GRFU-BYHA-6MYJ-FGNK-F9XA

Submit

[How do I register?](#) | [What is a registration code?](#)

Need to purchase?

No registration code, no problem. You can buy access to General Chemistry: The Essential Concepts right now. All you need is a credit card.



Buy Online

Need Temporary Access?

You can get two week access to your course materials. After that your work will be archived and you can purchase access.

Start courtesy access

(Older screenshot, may look slightly different now)

Useful Information: Connect Assignments

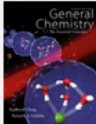
Required

NOT
Required

Assignment list			
Ungrouped Assignments			
	Due Date	Status	Attempts Remaining
 Chapter 1 Homework	01/29/18 11:59PM		Unlimited
 Chapter 1. Introduction	01/25/18 11:59PM		N/A
 Chapter 1 Practice	05/31/18 11:59PM		Unlimited

Section info

Instructor
Maria Donnelly

eBook
 **General Chemistry: The Essential Concepts**
Raymond Chang, Kenneth Goldsby 7

Assignment list			
Ungrouped Assignments			
	Due Date	Status	Attempts Remaining
 Chapter 1 Homework	09/15/17 11:59PM		Unlimited
 Chapter 1. Introduction	12/11/17 11:59PM		N/A
LearnSmart Assignment			
 Chapter 2. Atoms, Molecules, and Ions	12/11/17 11:59PM		N/A

LS = Learnsmart

Learnsmart assignments for chapters 1 & 2

Link to Learnsmart
practice problems

General Chemistry - General Chemistry: The Essential Concepts - Chang/Goldsby, 7e, Introduction

Introduction

Essential Concepts

1.1 The Study of Chemistry

1.2 The Scientific Method

1.3 Classifications of Matter

1.4 Physical and Chemical Properties of Matter

Practice

Outline chapter

1 / 782

Chemistry Labs Start This Week!!!

Safety Training is required for all Chem. Labs

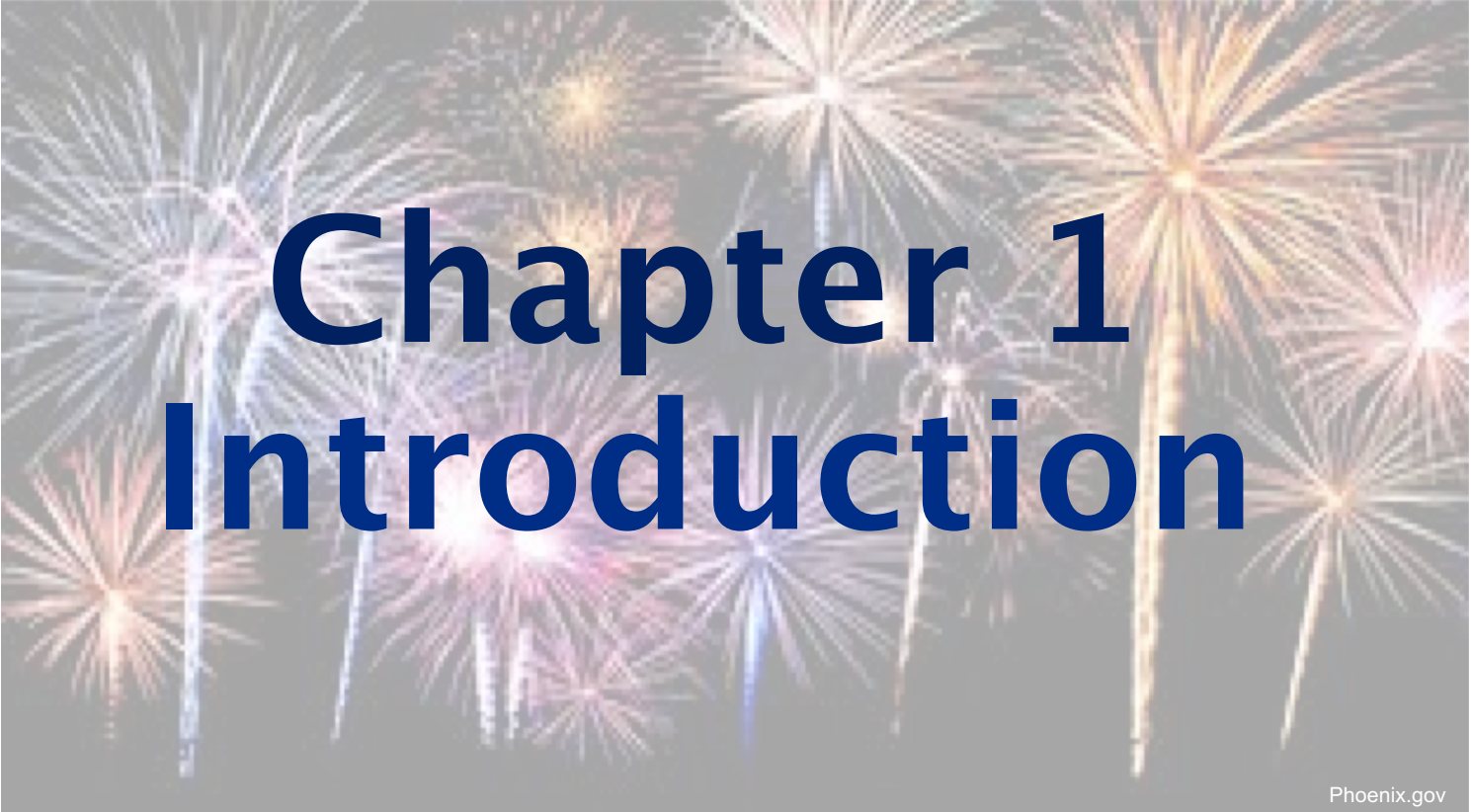
You must complete the required on-line lab safety module before your second lab session or you will not be able to participate in that lab – CHM 102 has only ONE make-up lab!

If you miss your first lab:

1. Attend a makeup lab session by **Tuesday September 9th**, ideally in the same room
2. You must attend a safety training specific to your course (see ecampus for times)
3. Attend your assigned lab next week

If you want to get into a lab:

1. Complete the safety module and add your name to the Wait List at www.chm.uri.edu
2. Attend a safety training session
3. You will be emailed a permission number if an opening becomes available



Chapter 1

Introduction

The science that studies the properties of substances & how substances react with one another.

How stuff works on a molecular/atomic/subatomic level

Chemistry!

MATTER

Has mass &
takes up
space



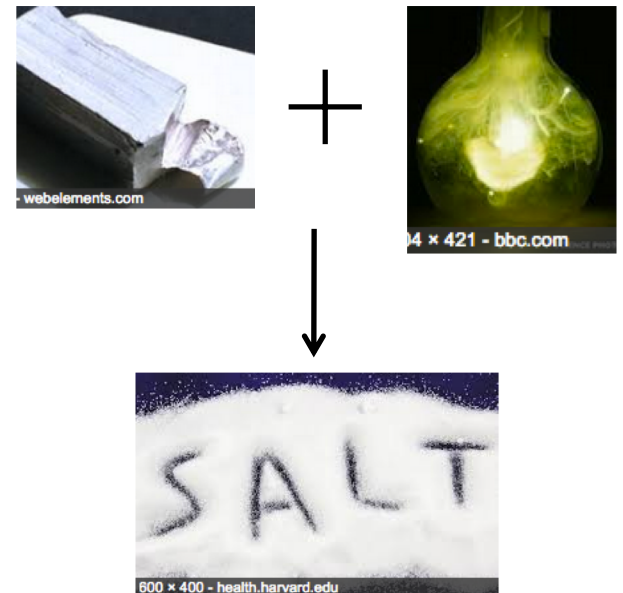
ENERGY

The capacity to do
work or cause
change



REACTIONS

How materials
interact & change

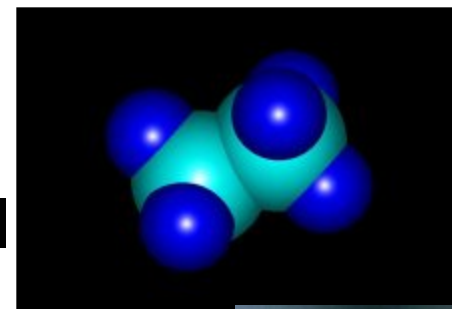


Learning the Language

Chemistry describes materials and predicts behavior using three basic concepts

Composition

- Mass percent of elements/compounds present
- Atomic/molecular ratios within material
- Stoichiometry



Structure

- Molecular/ionic/atomic arrangement
- Phase (solid, liquid, gas)



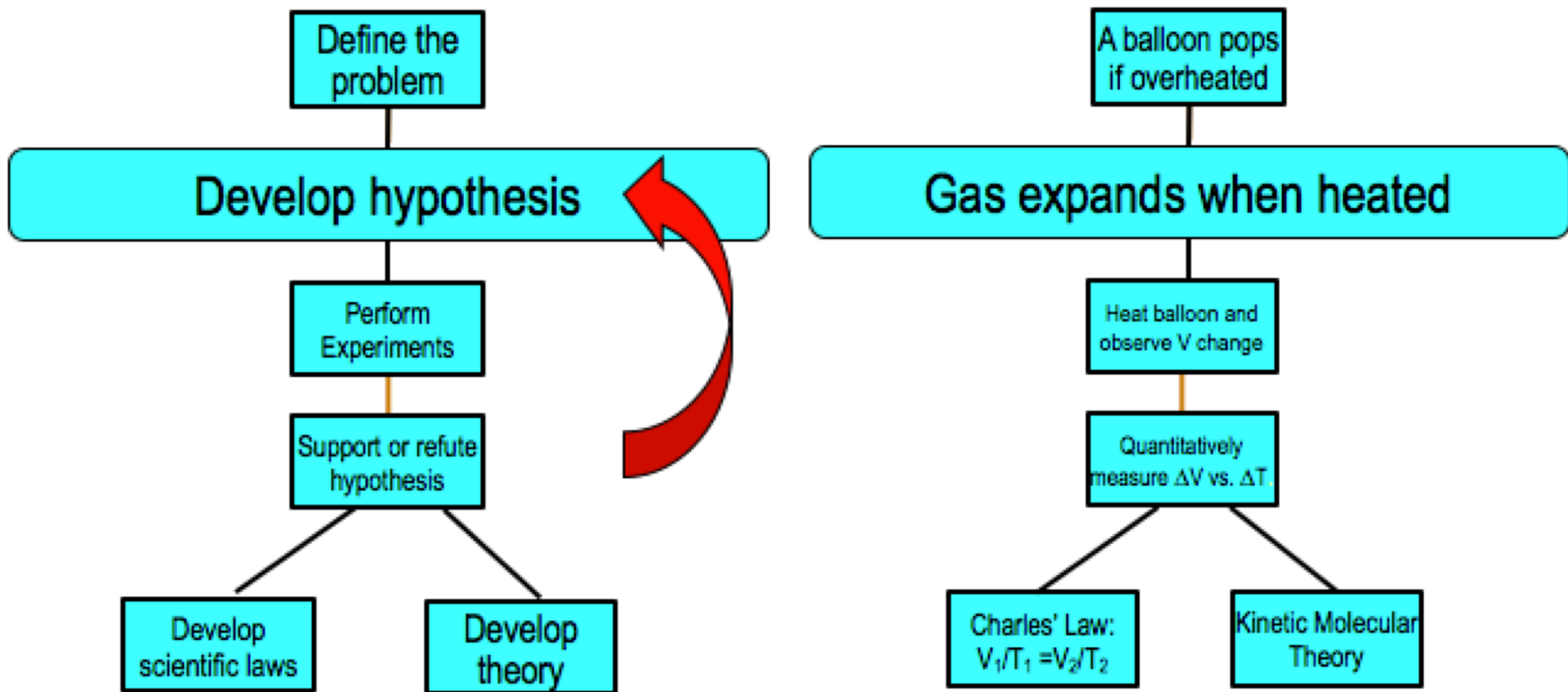
Properties – chemical & physical

- Specific to a particular material
- ex: boiling point, color, odor, reactivity
- Used for identification



The Scientific Method

Series of steps that explain an observation



Molecules move faster when heated requiring more space, causing balloon to pop.

Classifications of Matter

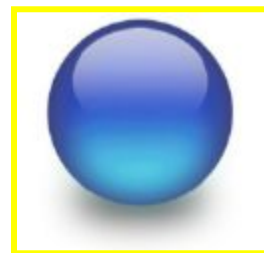
What is in the material you are investigating?



Pure materials

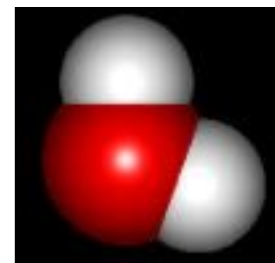
Atom:

- Smallest distinctive unit w/ properties of element



Molecule:

- 2 or more atoms together



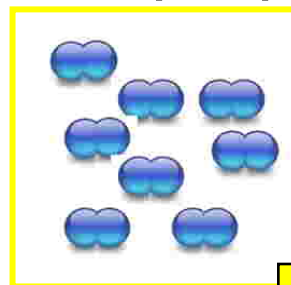
Pure Substance:

- Definite/constant composition & distinct properties

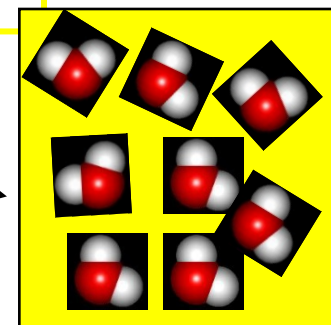
- **TWO** types of pure substances:

- **Element** → one type of atom →

- **Compound** → more than one type of atom chemically bonded



- **Compounds contain more than one element – still a pure substance!!!**



Mixtures

Mixture: Combination of 2 or more pure substances

- Can be separated by physical means

Homogeneous Mixture

- Substances stay mixed
- No distinct layers
- Uniform properties
- Also called a **“solution”**



14 karat gold
Mixture of gold and silver

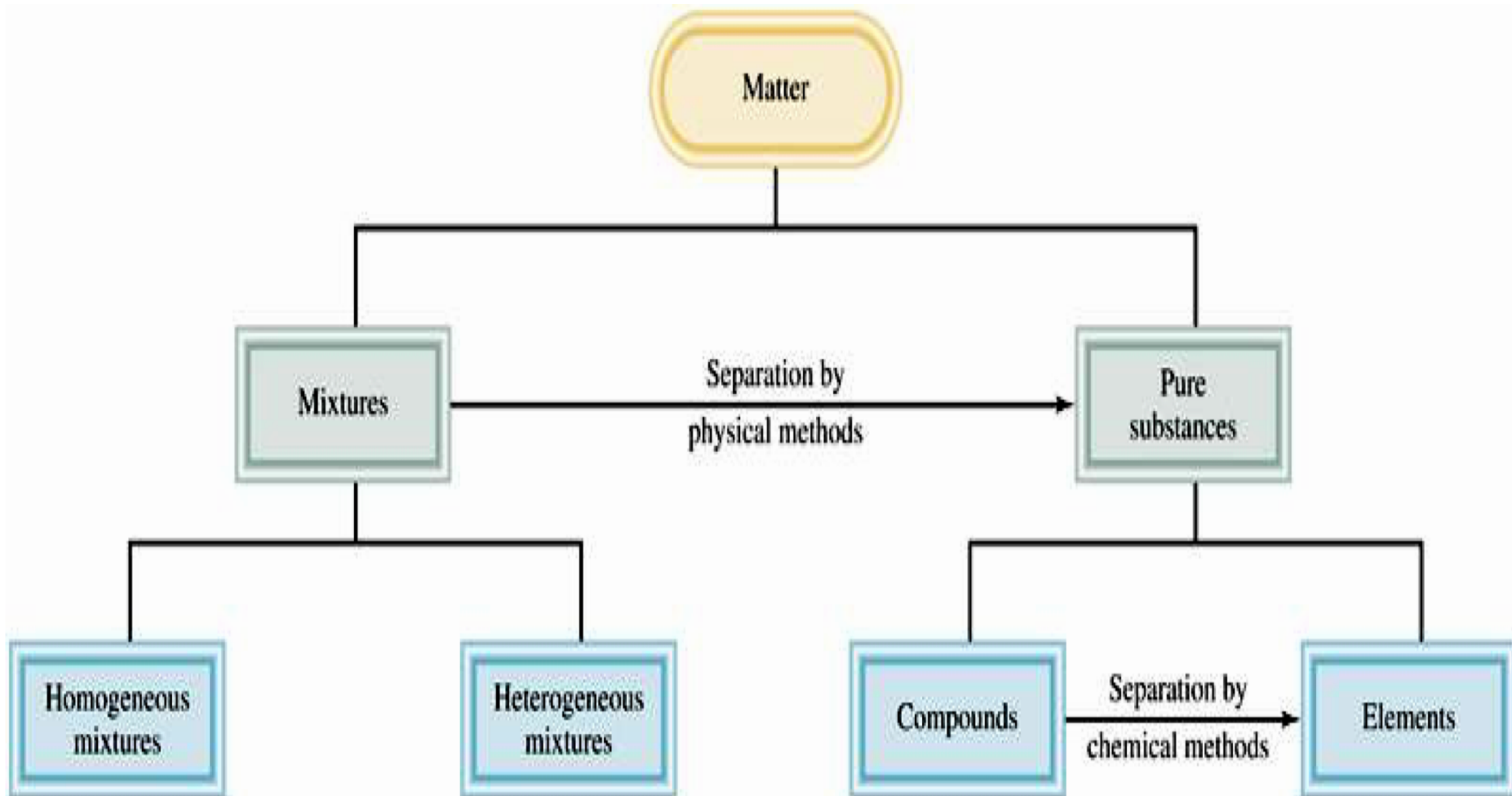
Heterogeneous Mixture

- Substances separate easily
- Distinct layers often seen
- Properties may not be uniform



Iron filings and sand

Matter Summary



Heterogeneous mixture

Homogeneous mixture

Pure Substance



Physical and Chemical Properties of Matter

Can be used to identify & separate substances



Physical Properties of Matter

Can be changed without changing molecular composition

Chemical identity is NOT CHANGED

eg: smashing a window – still glass
melting ice – still water

Phase changes are physical changes
(solid to liquid to gas etc.)

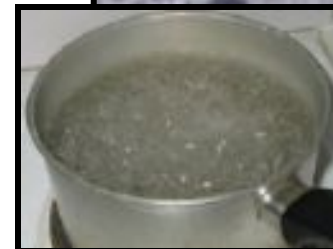
Melting, freezing, boiling, etc.

**CHEMICAL BONDS ARE NOT BROKEN
DURING PHASE CHANGES!**

Can be used to ID a substance without damage

Color, odor, solubility, conductivity, density
molecular mass, boiling/melting points

Original compound can be recovered



Chemical Properties of Matter

Describe how chemicals react with each other

What will they react with?

How will they react?

- Generate heat or light?
- Burn? Explode?
- Decompose slowly? (Rusting, rotting)



Compositional changes to molecules

- Often called a chemical change
- Original material changed on an atomic level



Original compound no longer present

- Compound cannot be restored to its original form without another chemical change

Extensive and Intensive Properties

Extensive Property: Depends on amount of matter present

ex: mass, length, volume, heat,
intensity of color or odor



Intensive Property: Independent of amount of matter present

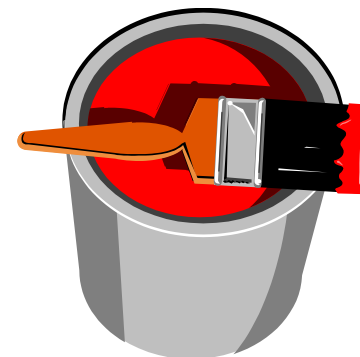
ex: Temperature, boiling point, color, odor

Often a calculated ratio

ex: Density (mass/vol ratio)

Molar mass (grams/mol)

Specific heat (J/g)



Intensive properties can be used to identify a material,
extensive properties cannot. Why?

Measurements

Determining how much matter is present



olin.edu



amazon.com

Base Units of Measurement

International System of Units (SI)

TABLE 1.2 **SI Base Units**

Base Quantity	Name of Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electrical current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol

Will be used frequently in CHM 101; you are expected to know them! (Depending on other classes, will likely need to know ampere in the future.)

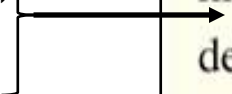
SI Prefixes

Yes, you need to know these too

TABLE 1.3 Prefixes Used with SI Units

Prefix	Symbol	Meaning
tera-	T	1,000,000,000,000, or 10^{12}
giga-	G	1,000,000,000, or 10^9
mega-	M	1,000,000, or 10^6
kilo-	k	1,000, or 10^3
deci-	d	1/10, or 10^{-1}
centi-	c	1/100, or 10^{-2}
milli-	m	1/1,000, or 10^{-3}
micro-	μ	1/1,000,000, or 10^{-6}
nano-	n	1/1,000,000,000, or 10^{-9}
pico-	p	1/1,000,000,000,000, or 10^{-12}

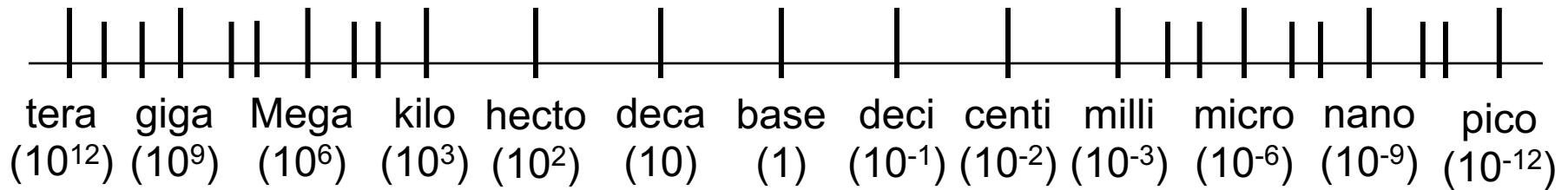
hecto (10^2)
deca (10^1)
Base



**The Great Majestic King Henry Died By
Drinking Chocolate Milk at Mad Nick's Palace**

The Great Majestic King Henry Died By Drinking Chocolate Milk at Mad Nick's Palace

Metric System is Base 10 – essentially just moving the decimal point



$$25 \text{ m} = 0.00000000000025 \text{ Tm}$$

$$25 \text{ Tm} = 25,000,000,000,000 \text{ m}$$

$$25 \text{ m} = 0.000000025 \text{ Gm}$$

$$25 \text{ Gm} = 25,000,000,000 \text{ m}$$

$$25 \text{ m} = 0.000025 \text{ Mm}$$

$$25 \text{ Mm} = 25,000,000 \text{ m}$$

$$25 \text{ m} = 0.025 \text{ km}$$

$$25 \text{ km} = 25,000 \text{ m}$$

$$25 \text{ m} = 0.25 \text{ hm}$$

$$25 \text{ hm} = 2500 \text{ m}$$

$$25 \text{ m} = 2.5 \text{ dam}$$

$$25 \text{ dam} = 250 \text{ m}$$

$$25 \text{ m} = 25 \text{ m}$$

$$25 \text{ m} = 25 \text{ m}$$

$$25 \text{ m} = 250 \text{ dm}$$

$$25 \text{ dm} = 2.5 \text{ m}$$

$$25 \text{ m} = 2500 \text{ cm}$$

$$25 \text{ cm} = 0.25 \text{ m}$$

$$25 \text{ m} = 25000 \text{ mm}$$

$$25 \text{ mm} = 0.025 \text{ m}$$

$$25 \text{ m} = 25,000,000 \text{ } \mu\text{m}$$

$$25 \text{ } \mu\text{m} = 0.000025 \text{ m}$$

$$25 \text{ m} = 25,000,000,000 \text{ nm}$$

$$25 \text{ nm} = 0.000000025 \text{ m}$$

$$25 \text{ m} = 25,000,000,000,000 \text{ pm}$$

$$25 \text{ pm} = 0.00000000000025 \text{ m}$$

Metric Conversion Examples

1.) Convert 256.74g to kg
(0.25674 kg)

2.) How many milliliters are in 3.78 L?
(3780 mL)

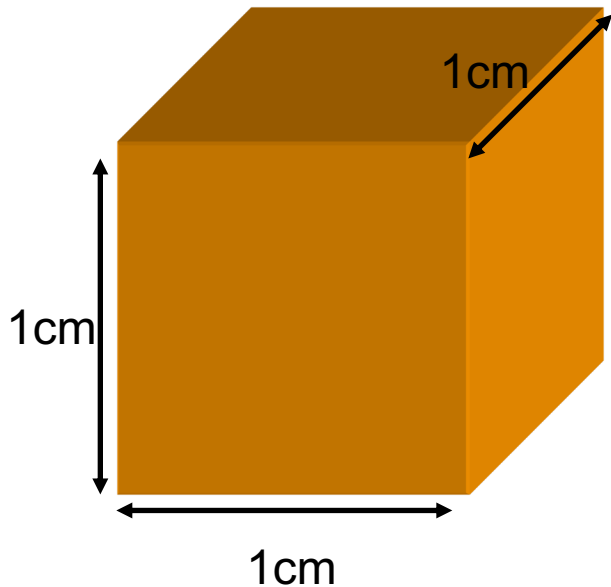
3.) Convert 18000000 cm into Mm
(0.18 Mm)

Derived Units: Volume

SI derived unit for volume is a cubic meter (m^3)

Common unit is a “**Liter (L)**”

$$1L = 1000cm^3 = \frac{1000cm}{1} \times \frac{1cm}{1} \times \frac{1cm}{1} \times \frac{1m}{100cm} \times \frac{1m}{100cm} \times \frac{1m}{100cm} = 1 \times 10^{-3} m^3$$



$$\underline{1\text{ L} \neq 1\text{ m}^3}$$

$$\underline{1\text{ L} = 1 \times 10^{-3} m^3}$$

$$\underline{1\text{ mL} = 1\text{ cm}^3}$$



Metric Conversions with Units that are squared (s^2), cubed (cm^3), etc. can be tricky:

ex.) Convert 87856 cm^3 to m^3

Note: $1 \text{ m} = 100 \text{ cm}$ but $1 \text{ m}^3 \neq 100 \text{ cm}^3$

Need to do the conversion 3x for cubed numbers
(2x for squared, etc.)

$$87856 \text{ cm}^3 = 0.087856 \text{ m}^3$$

Derived Units: Density

Density: Ratio of mass to volume of a material

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{m}{V}$$

SI derived unit for density is kg/m^3

$$1 \text{ g/cm}^3 = 1 \text{ g/mL} = 1000 \text{ kg/m}^3$$

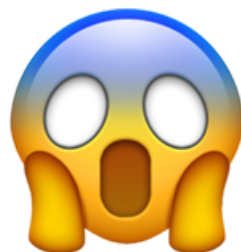
Substance	Density (g/cm^3)
Air*	0.001
Ethanol	0.79
Water	1.00
Mercury	13.6
Table salt	2.2
Iron	7.9
Gold	19.3

Intensive property

- Can be used to identify a material
- Units of mass and volume may vary

Handling Numbers

Math Review



Significant Figures:

Number of Digits to Report in Final Answer

1. All non-zero digits are significant
2. Use decimal point to decide if zeros are significant

Between 2 numbers	significant	<u>50.00</u> 2	5 sig figs
Before decimal point	not significant	0. <u>50</u> 2	3 sig figs
Before the first digit	not significant	0. <u>00</u> 52	2 sig figs
End of # after decimal	significant	0.02 <u>00</u>	3 sig figs
No decimal point:	not significant	5 <u>00</u>	1 sig fig

3. Exact numbers have unlimited number of sig. figs.

Inherently an integer:	e.g. 4 sides to a square
Inherently a fraction:	e.g. $\frac{1}{2}$ of a pie
Obtained by counting:	e.g. 47 people in a class
Defined quantity:	e.g. 12 eggs in a dozen

Determining the correct number of significant figures (sigfigs) in math problems:

Answer is based on the LEAST significant value

Addition/subtraction – Sig figs based on decimal

$$\begin{array}{r} 1500 \\ + 2976 \\ \hline 4476 \end{array} \longrightarrow 4500$$

$$\begin{array}{r} 12.45\text{XX} \\ - 9.2680 \\ \hline 3.1820 \end{array} \longrightarrow 3.18$$

Multiplication/Division – Sig figs based on all sig digits

$$\begin{array}{l} 4 \text{ sig figs} \\ 3.182 \times 3.57 = 11.35974 \end{array} \xrightarrow{3 < 4 \text{ so } 3 \text{ sig figs}} 11.4$$

3 sig figs

Rounding is based on number after last sigfig:

≥ 5 round up ≤ 5 round down

Multiple math functions – follow order of ops

$$(12.45 - 9.2680) \times 3.575 = 11.37565$$

Step one: Subtraction → Sigfigs based on decimal

$$(12.\underline{45} - 9.\underline{2680}) = 3.182$$

2 sigfigs after decimal

3 sigfigs overall in final answer

$$\begin{array}{r} 12.45\text{XX} \\ - 9.2680 \\ \hline 3.18\text{20} \end{array}$$

Step two: Multiplication → Sigfigs based on all sig digits

$$\underline{3.18}\text{2} \times 3.575 = \underline{11.3}\text{7565}$$

3 sigfigs in 1st number, 4 in 2nd → 3 in final answer

Here addition limits sigfigs

Round up because the next number is >5

$$\underline{11.3}\text{7565} \rightarrow \boxed{11.4}$$

Why do significant figures matter?

123.52 cm



121 cm



Width of room: 244.6 cm
Will the two desks fit?

$$\begin{array}{r} 123.52 \text{ cm} \\ + 121.?? \text{ cm} \\ \hline 244.52 \text{ cm} \end{array}$$

Fitting desks in a room may not seem all that important – but the same concept is true for the design of buildings & bridges!

Scientific Notation

For very large or very small numbers

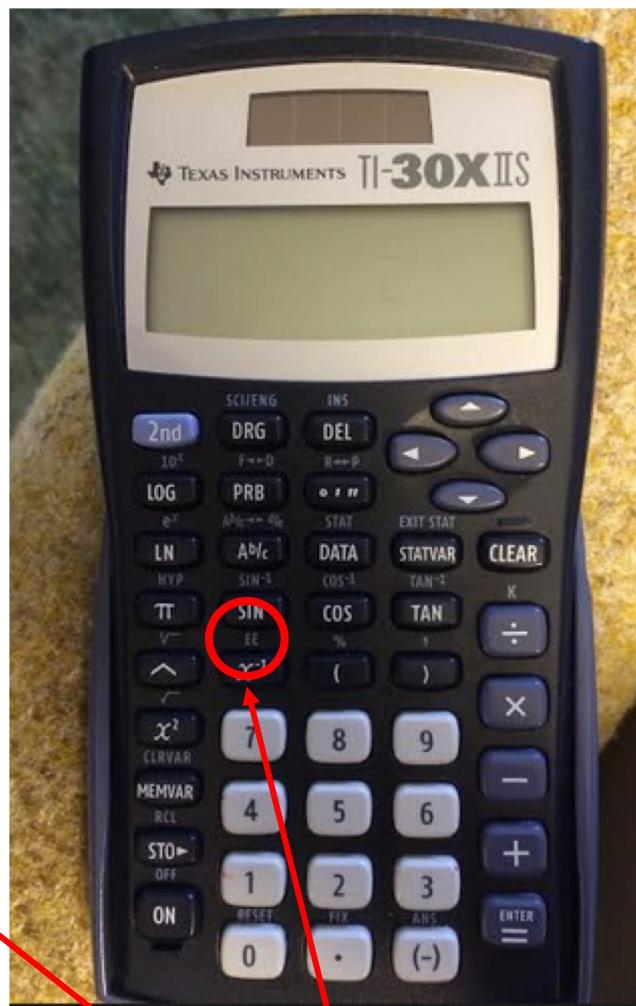
Significant digits $\longrightarrow$ **1.7** **x** **10**⁶ $\longleftarrow$ Size of number
(multiplier)

1700000 $\rightarrow$ **1.7** **x** **10**⁶ $\longleftarrow$ Positive exp = large number (>1)

0.0000017 $\rightarrow$ **1.7** **x** **10**⁻⁶ $\longleftarrow$ Negative exp = small number (<1)

Rules:

- Keep all significant numbers
- Place decimal after 1st significant number (**1.7**)
- To get exponent:
 - Count number of places decimal moved to get to correct location (after 1st significant number). This value is your exponent.
 - If the number is >1, exp is positive **1700000** $\rightarrow$ **1.7** **x** **10**⁶
 - If the number is <1 exp is negative **0.0000017** $\rightarrow$ **1.7** **x** **10**⁻⁶



Use **EXP**, **SCI**, **EE** or **x10^x** keys on calculator

Scientific Notation Examples

Write the Following in
Scientific Notation:

1.) 280000000

2.) 280.0

3.) 0.000000004577

4.) 0.00000060

Write the Following
in Standard Format:

1.) 2.45×10^2

2.) 3.98×10^6

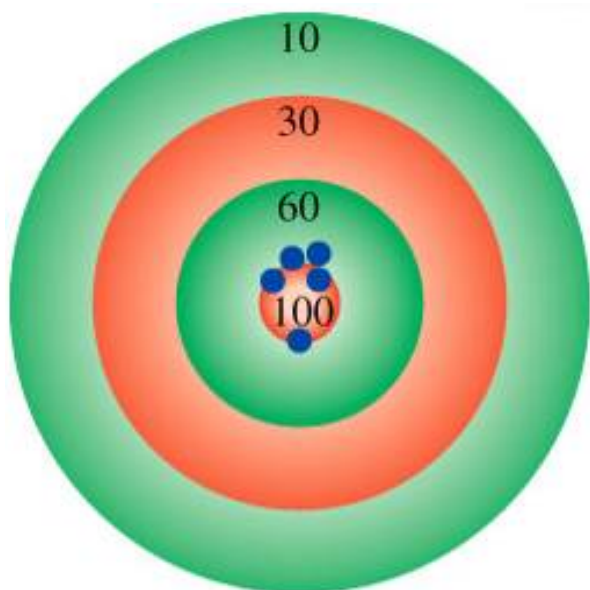
3.) 4.29×10^{-3}

4.) 8.0×10^{-6}

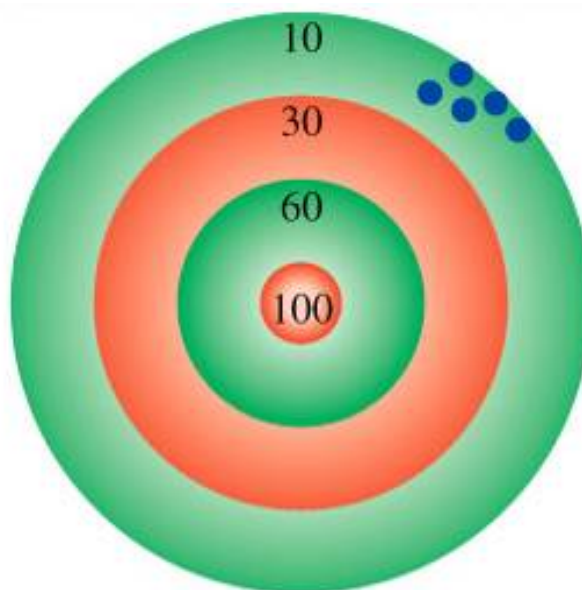
Precision and Accuracy

Accuracy – how close a measurement is to the true value

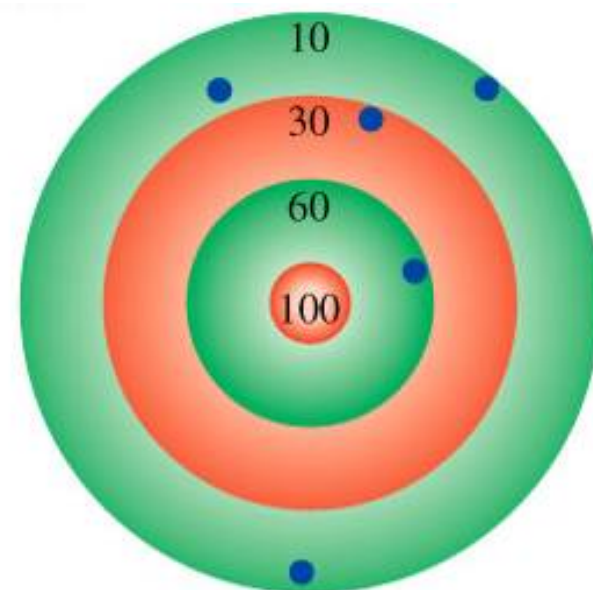
Precision – how close measurements are to each other



accurate
&
precise



precise
but
not accurate



not accurate
&
not precise

Percent Error

Comparison of experimental results to expected or real values

- Usually reported without a + or - sign

$$\% \text{ error} = \left(\frac{|\text{Experimental value} - \text{Real value}|}{\text{Real value}} \right) \times 100$$

Experimental value - Real value = **Deviation**

- Often reported with a + or - sign

Real value:

- Widely accepted, often an industry standard value
- Average of several experiments can sometimes be used if real value is unknown

Dimensional Analysis

Algebra and canceling units

Look at question:

How many kilograms of methanol will fill a 15.5 gallon fuel tank of a car modified to run on methanol? (Density of methanol = 0.791 g/mL)

What unit do you want to solve for?

What information do you need?

Data in problem:

Data to look up:

Data to know:

Dimensional Analysis Problems

1) How many kilograms of methanol will fill a 15.5 gallon fuel tank of a car modified to run on methanol? (Density of methanol = 0.791 g/mL; 1 gal = 3.785 L) **A: 46.4 kg**

2) How many liters are equal to 500. cm³? A: 0.500 L

3) A cube with sides measuring 7.50 m has a mass of 0.04567 mg. What is the density of the cube in $\mu\text{g/mL}$? A: $1.08 \times 10^{-7} \mu\text{g/mL}$